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Comparing Software Acquisition Models Against Each Other: The "Build" vs. "Buy" vs. "Rent" Trade Study

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Preface & Acknowledgements

Welcome to our Ninth Annual Acquisition Research Symposium! This event is the highlight of the year for the Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) because it showcases the findings of recently completed research projects—and that research activity has been prolific! Since the ARP's founding in 2003, over 800 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at www.acquisitionresearch.net, at a rate of roughly 140 reports per year. This activity has engaged researchers at over 60 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a “broker” to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and hope this symposium will spark even more participation.

We encourage you to be active participants at the symposium. Indeed, active participation has been the hallmark of previous symposia. We purposely limit attendance to 350 people to encourage just that. In addition, this forum is unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. Seldom will you get the opportunity to interact with so many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. In the words of one senior government official, “I would not miss this symposium for the world as it is the best forum I’ve found for catching up on acquisition issues and learning from the great presenters.”

We expect affordability to be a major focus at this year’s event. It is a central tenet of the DoD’s Better Buying Power initiatives, and budget projections indicate it will continue to be important as the nation works its way out of the recession. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you’re a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

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- Program Executive Officer, Littoral Combat Ships

We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this symposium.

James B. Greene Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor



Panel 23. Dimensions of Software Acquisition

Thursday, May 17, 2012	
3:30 p.m. – 5:00 p.m.	<p>Chair: Reuben Pitts, President, Lyceum Consulting, LLC</p> <p><i>Total Ownership Cost a Decade Into the 21st Century</i> Brad Naegle and Michael W. Boudreau <i>Naval Postgraduate School</i></p> <p><i>Navigating Beyond the SLOC: Exploring Alternatives for Software Estimating</i> Kathlyn Loudin and Eric D. Rocholl <i>Naval Surface Warfare Center, Dahlgren Division</i></p> <p><i>Comparing Software Acquisition Models Against Each Other: The "Build" vs. "Buy" vs. "Rent" Trade Study</i> Ron Kohl, <i>R.J. Kohl & Associates</i></p>

Reuben Pitts—Mr. Pitts is the president of Lyceum Consulting. He joined the Naval Weapons Lab in Dahlgren, VA, in June 1968 after graduating from Mississippi State University with a BSME. His early career was spent in ordnance design and weapons systems. He subsequently served on the planning team to reintroduce the Navy to Wallops Island, VA, currently a multiple ship combat, over-the-water weapons testing lab for Surface Ship Combat Systems, Fighter Aircraft, and live missile firings. His outstanding service as the deployed Science Advisor to Commander, U.S. Sixth Fleet was recognized with the Navy's Superior Civilian Service (NSCS) Award and the Navy Science Assistance Program Science Advisor of the Year Award.

Mr. Pitts was selected to lead the technical analysis team in support of the formal JAG investigation of the downing of Iran Air Flight 655 by USS *Vincennes*, and participated in subsequent briefings to CENTCOM, the Chairman of the Joint Chiefs, and the Secretary of Defense. As head, Surface Ship Program Office and Aegis program manager, Mr. Pitts was awarded a second NSCS, the James Colvard Award, and the John Adolphus Dahlgren Award (Dahlgren's highest honor) for his achievements in the fields of science, engineering, and management. Anticipating the future course of combatant surface ships, Mr. Pitts co-founded the NSWCDD Advanced Computing Technology effort, which eventually became the Aegis/DARPA-sponsored High Performance Distributed Computing Program; the world's most advanced distributed real-time computing technology effort. That effort was the foundation for the Navy's current Open Architecture Initiative.

In 2003 Mr. Pitts accepted responsibility as technical director for PEO Integrated Warfare Systems (IWS), the overall technical authority for the PEO. In September of that year, he was reassigned as the major program manager for Integrated Combat Systems in the PEO. In this position, he was the program manager for the Combat Systems and Training Systems for all U.S. Navy Surface Combatants, including Aircraft Carriers, Cruisers, Destroyers, Frigates, Amphibious Ships, and auxiliaries. In July, 2006, Mr. Pitts returned to NSWCDD to form and head the Warfare Systems Department. While in this position, he maintained his personal technical involvement as the certification official for Surface Navy Combat Systems. He also served as chair of the Combat System Configuration Control Board and chair of the Mission Readiness Review for Operation Burnt Frost, the killing of inoperative satellite USA 193.

Mr. Pitts has been a guest speaker/lecturer/symposium panelist at many NAVSEA-level and DoD symposiums, conferences and at the Naval Postgraduate School, the Defense Systems Management College, and the National Defense University. For 19 years Mr. Pitts was the sole certification authority of all Aegis Combat System computer programs for fleet use. He retired from the U.S. Civil Service in September 2008, with over 40 years of service to the Navy.



Comparing Software Acquisition Models Against Each Other: The "Build" vs. "Buy" vs. "Rent" Trade Study

Ron Kohl—Kohl has been involved in the large systems integration business for over 30 years. Kohl started by working on NASA's Space Shuttle and Space Station programs (Onboard Flight Software systems) while with IBM's Federal Systems Division in Houston. He has spent several years with Loral's and Lockheed Martin's Federal Systems Headquarters technical staff, and then with Lockheed Martin's Software and Systems Resource Center (SSRC). Kohl worked with Titan Systems Co.—Civil Government Services Group as the chief systems engineer for NASA programs. He is now president of R. J. Kohl and Associates, a consulting firm offering systems engineering and technical project management services to various government and industry customers. Kohl's areas of space interest include LEO infrastructure services, socio-cultural aspects of space settlements, the future space-based workforce, and the commercialization of space. He is a member of the AIAA Space Colonization Technical Committee. Kohl's technical interests include systems engineering, software engineering, risk management, COTS-based systems, and measurements. He is a member of the IEEE Reliability Society, the IEEE Standards Association, and the AIAA Computer Systems Technical Committee. Kohl has a BS in mathematics from the University of Wisconsin—Oshkosh and an MS in mathematics from Southern Illinois University—Edwardsville. [rjkohl@prodigy.net]

Abstract

Software can currently be acquired in three different methods. The first is to have software custom built/developed to match a particular specification/requirement. We shall refer to this option as "make." The second is to purchase a software product from a vendor/supplier. We shall refer to this option as "buy." The third is to rent/outsourcing the use of a software product or a software development environment from a third-party supplier. We shall refer to this option as "rent." It seems that what is lacking is some guidance to help acquirers decide which of these three software acquisition approaches to consider and, eventually, to select. This lack of objective, quantitative guidance (including risks associated with each option, decisions needed for each option, etc.) causes acquirers to sometimes make ill-informed decisions about which acquisition method to use. This paper identifies some of the differences between these three acquisition models as mapped against several life cycle phases and project activities, and then identifies risks associated with the "rent" option.

Overview

Software can currently be acquired in three reasonably different methods and each of these methods has different benefits, risks, and decisions to address as part of a software acquisition activity.

The first is to have software custom built/developed to match a particular specification/requirement. We shall refer to this option as "build."

The second is to purchase a software product from a vendor/supplier. Commercial off-the-shelf (COTS) software is one such example. There are other types of pre-built, packaged software products, intended to be used in mostly "as-is" condition in this category. We shall refer to this option as "buy."

The third is to rent/outsourcing the use of a software product or a software development environment from a third-party supplier. A subset of the Cloud Computing (CC) paradigm would be considered part of this option. Note that in this option we typically refer to the software acquired as a "service," rather than a product, since the software itself is not physically obtained by the acquiring organization. We shall refer to this option as "rent." While some definitions of CC include both internal and external CC providers, this paper focuses only on the third-party CC model, not the internal CC model.



While IEEE 1062, Recommended Practice for Software Acquisition, provides some comparison between the “build” and “buy” acquisition options, it does not address the “rent” option, which is the focus of this paper. In this paper, I compare certain aspects of the CC model against the “build” acquisition model, and certain other aspects of the CC model against the “buy” acquisition model. It is the author’s hope, being a current member of the IEEE 1062 update team, that some future version of this IEEE standard will include information about this CC (i.e., “rent”) option.

So, What’s the Problem?

It seems that what is lacking or not fully developed is some guidance to help acquirers decide which of these three software acquisition approaches to consider and eventually select, or to help acquirers assess a supplier’s proposal to adopt one of them. This lack of objective, quantitative guidance (including risks associated with each option, decisions needed for each option, etc.) causes acquirers to sometimes make ill-informed decisions about which acquisition method to use (or which combination of methods to use). Creating some guidance for software acquirers that will help them make effective trade studies leading to a choice of one (or more) of these acquisition options should improve the quality of both the software to be acquired and the overall system in which that software will be executed. This paper identifies risks with the three major categories of development, test, and maintenance, and suggests some differences between these three acquisition models as mapped against various life cycle phases and project activities.

Definitions for CC Options

- SaaS: A model in which an organization basically rents an application, paying a flat monthly fee based on the number of transactions, users, or employees.
- IaaS: Off-loading the guts of an organization’s data center, such as servers and networking, to a cloud provider. It is attractive to organizations that do not want to manage their infrastructure, undertake an infrastructure upgrade, or deal with scalability issues, and that would prefer to off-load that responsibility to a third party.
- PaaS: A cloud service that consists of an entire platform—user interfaces, workflow engines, database services, and security/authentication—complete with tools to walk you through the application-building process. This aspect of CC is essentially the outsourcing of the Software Development Environment (SDE) for a custom-built software project.

Example

Here is an example of a software need and how these three acquisition methods create differences to consider. Suppose we have a need for an accounting package (for example, General Ledger [GL]). We could solicit and then hire a software developer to create a custom-built software product to meet our needs. Alternatively, we could visit the COTS marketplace and try out a few different GL packages and then select one to meet our needs. Finally, we could visit the Cloud Computing world (and other “rent a software product” options) to see if there is a supplier offering the use of a GL package to perform our GL processing. We could assess the options and then select one that meets our needs.

We should note that in certain application domains, we may not have all of these options to consider. For example, if we need a unique software application to support a new spacecraft system, then we may only have the “build” option. Another example might be the need for an integrated accounting, inventory control, and logistics software product. In this



case, we may have only the “build” and “buy” options, as there may not yet be a CC supplier offering such an integrated package.

So, What Should We Do About It?

First, I present a set of risk areas/questions that relate to software acquisition in general, and, in some cases, to the CC approach in particular. This list provides a starting point (but is not intended to be a complete list) of the kinds of questions that acquirers should be asking and, depending on the answers received, can lead to identifying risk areas associated with a particular acquisition approach. I then map certain of these risks/questions to three major phases in software acquisition (pre-solution selection phase, solution selection and system development phase, operations (Ops)/maintenance phase) and provide more detail.

Risk Areas

1. Access to assets/resources—What if my access to these services/products is interrupted or lost?
2. Information security—Is my property appropriately protected?
3. Support to users—What if the acquirer/users claim they found a problem in the service/product? If the acquirer would like to request a new feature/capability, how receptive is the vendor/supplier to such requests?
4. CC service “users groups”—Many COTS vendors have “user groups” that allow the users of the product to gather together to share information. Is there anything equivalent in the CC world?
5. Managing version/upgrade control—What happens when the CC vendor decides to make changes to the services or products that they rent out to acquirers? How many such versions are supported by the vendor/supplier? What happens if an acquirer is using a version that is no longer supported?
6. Vendor viability—What if my CC vendor goes out of business?
7. Performance—Am I getting the responsiveness and availability that was advertised?
8. Capacity—Am I getting the advertised number of users using the CC services? Do the CC services provide enough space/resources to support my capacity needs?
9. Role of internal IT staff/services in a CC world
 - a. Internal staff may have to act as a liaison to the CC vendor/services
 - b. Internal staff may have to learn new skills (technical, business, customer support, etc.)
10. Consistency of internal IT assets/resources/staff versus CC vendor services
 - a. Do internal staff skills need to be expanded?
 - b. Does new staff need to be hired?
 - c. Are internal tools/methods consistent with CC vendor tools/methodologies (e.g., is my CM tool compatible with the CC vendor’s CM tool)?

Three Major Phases in a Software Acquisition Life Cycle

For the acquisition of any software product or software service, there are a common set of interests, such as assessing the quality of the vendor, the likely quality of the product, security and availability issues, and so forth. But from a software acquirer’s perspective, the



nature of the risks and any possible mitigation steps may differ, depending on where in the overall software acquisition and project life cycle the acquirer is at. I identify these areas of risk based on the three phases discussed in the following list, and pose some questions that can help to determine whether a given risk area is applicable to or is likely to emerge in a given phase.

1. Prior to selecting a product/service and the appropriate supplier
 - a. Quality of the software product: Has this provider done similar work on past projects? Was that work considered acceptable by the customer? Is there a large user base?
 - b. Technical quality of the supplier of the software product: What is the quality of the technical processes used by this supplier (e.g., CMMI Level 3, ISO 9001)? Has this supplier done other projects in this application domain? If yes, will the supplier share details about those other projects? How does the supplier collect defect reports from the user base? Are those defect reports shared with the user base? Will the supplier share the criteria by which they declare an alleged defect to be an actual defect or by which it gets rejected?
 - c. Business viability of the supplier of the software product: Has this provider been in business for a long time or not? How big a portion of the marketplace does this provider “own”? Does this provider have a user base that has its own user’s group? What is the likelihood of this provider being around long enough to provide support during the development and Ops/maintenance phases?
 - d. Security: Is any information/data that is produced by this product or service fully protected? Is there any concern about malware, hacker access, or other intrusion threats?
 - e. Availability: Can I always get to my information? Can I always have use of the product/service? Can the product/service run continuously for an advertised length of time before failing (i.e., is there an availability or reliability attribute)?
 - f. Supportability: Does the provider offer product support/training? If there are multiple versions/releases of the product, which ones will be supported and for how long? What are my options if I am using a version/release that no longer is supported by the provider?
 - g. What are my product/service acceptability criteria? Some of the above? Other criteria?
 - h. What contracting vehicles are available to me to acquire this software, or access use of this software, from this supplier?
2. After selecting product/service/supplier combination, but prior to deployment into Operations; This includes any system development/test/integration processes that integrate this product/service into a larger system.
 - a. How well does the product/service working after I have acquired it?
 - b. What measures should I implement to monitor the use of this product/service?
 - c. What if I discover a defect? What if the supplier does not agree with me about an alleged defect?
 - d. How responsive is the supplier to my questions or other issues?



3. After system deployment into the Ops/maintenance mode
 - a. What if I discover a defect? What if the supplier does not agree with me about an alleged defect?
 - b. What if the supplier creates a new version/release of the product? Do I need to upgrade or can I remain on the current version? How many versions will the supplier support? What are my options if a version that I am using is no longer supported by the supplier?
 - c. What are the user's satisfaction criteria? Are these important to the vendor/supplier/developer?

Comparing Different Acquisition Methods

The three different acquisition methods (make, buy, rent) have different risk areas and different decisions that must be made when these methods are being considered for adoption and, eventually, selected as a preferred method. While these three methods have many differences, it is possible, even likely, that a given project/system will use more than one such approach. In fact, the overall acquisition approach could easily use more than one of these approaches and, thus, acquirers will likely need to consider the risks/decisions for each approach, as well as the combination of two or more.

IaaS (Infrastructure as a Service) Versus Internal IT Services

I will defer this comparison to a future paper, due to the lack of direct insight into this aspect of CC.

SaaS (Software as a Service) Versus COTS

This comparison will look at how an organization can compare “buy a commercial application” versus “rent access to and use of a commercial application.” In this comparison, I assume that the application is essentially the same application, and I focus on the differences in these two acquisition models.

The major differences between these two approaches is that in the COTS-based approach, the acquirer takes possession of the software product and, thus, gains greater control over access to it and utilization of it. But this control factor is balanced against the cost of acquiring the product, ensuring that there is internal staff (and skills) that can provide necessary support to the product. In addition, product version control (updates) is less impacted in the COTS-based approach due to having possession of a given version of the product. If the COTS vendor decides to create new versions or update/upgrade existing and deployed versions, the acquirer can choose to accept the change or defer that change. Such options may not be available if the CC vendor chooses to only offer the updated version or a newer version of their product.

PaaS (Platform as a Service) Versus Custom-Built Solution

This comparison looks at the differences between custom building an application using internal resources and internal staff versus using a rented development environment (e.g., tools, skills, resources) with both internal staff and some staff from the PaaS vendor.

The major difference here is, again, a matter of control of the development environment and the supporting tools and skills. In the custom-built software approach, the acquirer has possession of the tools, the methodologies, and the staff/skills, and can control all of these aspects of this acquisition approach. In the PaaS approach, the acquirer trades off this control for a, hopefully, reduced total cost of “development” and a shorter period to create, and start to use, the development environment.



Open Questions and Next Steps

Open Questions

- What role should the government (e.g., NIST, etc.) take in further expanding and enhancing these risk areas and possible risk-mitigation approaches? Are there other “communities of practice” that can contribute to this objective, honest-broker perspective on CC?
- Can these comparisons be expanded across all three methods to provide a “big picture,” side-by-side view of these three software acquisition approaches?

Next Steps

- Expanding the risk lists with additional risk areas (under construction)
- Developing a set of candidate risk-mitigation approaches to deal with these various risks (under construction)
- Investigating the ability to compare IaaS against other software or systems acquisition approaches

References/Resources

1. The National Institute of Standards and Technology (NIST; <http://www.nist.gov/itl/cloud/>) is a leader in identifying the government’s interests in Cloud Computing. Their website describes the various activities that they are leading or supporting related to furthering the successful use of CC.
2. The Cloud Standards Customer Council (<http://www.cloud-council.org/index.htm>) is an industry consortium intended to improve the adoption and use of CC.





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Comparing Software Acquisition Models against each other: the 'Build' vs 'Buy' vs 'Rent' trade study

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What is the problem?

- Cloud Computing (CC) has expanded the ‘make vs buy’ trade study to ‘make vs buy vs rent’
- Yet there is little guidance to help SW acquirers make this trade study
 - What are the risks associated with CC?
 - How can I compare CC against the other options?

What is the solution?

- Understand the risks associated with CC
- Understand how these CC risks relate to different phases of SW acquisition
- Be able to compare riskyness of each acquisition approach against the others

Definitions

- Cloud Computing (CC) - computing/SW products or services for 'rent' from some vendor
 - SaaS (Software as a Service): renting the use of a s/w application (e.g. accounting)
 - PaaS (Platform as a Service): renting the use of s/w tools to build your own s/w
 - IaaS (Infrastructure as a Service): use of physical computing products/services to support an org (e.g. IT services, data servers, etc)

Risks associated with CC

- Access to resources – does the vendor provide ‘guaranteed’ access or alternative access?
- Resource updates – how does the CC vendor manage updates to their products/services?
- Info Security – how does the CC vendor plan to protect your information?
- Vendor viability – what if the vendor goes out of business? What are your options?
- There are more in the paper and more that may not yet be identified or encountered.

how these CC risks relate to different phases of SW acquisition

- SW acquisition phases:
 - Prior to acquiring a SW product/service
 - After acquiring SW product/service but before operations (e.g. development, test, integration, etc)
 - After SW product/service is put into operations
- See 'IEEE P1062 Recommended Practice for Software Acquisition' for more details
- This list is 'under construction' and not part of this paper

Compare riskiness of each acquisition approach against the others (1)

- SaaS vs COTS (aka 'rent access to vs buy' a commercial SW product):
 - possession of product vs access to product
 - Internal staff/skill needs
 - Update/version control options
 - Information protection
 - Managing SW product/service defects

Compare riskiness of each acquisition approach against the others (2)

- PaaS vs Custom Built SW (aka 'rent access to SW dev environment vs internal SW dev environment'):
 - possession of product vs access to product
 - Capacity of users to access tools
 - Update/version control options
 - Information protection
 - Tool defects management

Next Steps

- Improve list of CC risk areas, map to phases
- Develop/improve risk mitigations for these CC risks
- Improve comparisons between 'make vs buy vs rent' acquisition models
 - Incorporate into IEEE 1062 Std?
- Government role in addressing these issues (e.g. NIST, etc)